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2.4 LAND INDICATORS

TABLE

2.4 LAND INDICATORS[1]

This chapter summarizes reviewer discussions and presents consensus conclusions and recommendations for EPA's proposed land indicators for the ROE Technical Document. The chapter is divided into 10 sections. The first five sections cover indicators in five topic areas: chemicals used on the land, waste, contaminated lands, land cover, and land use. The other five summarize reviewers' responses to general questions in those five topic areas.

Land indicators were reviewed by different groups of reviewers: land chemical indicators by the land chemical group; land waste and contaminated land indicators by the land waste group; and land cover and land use indicators by the ecological condition group. Some indicators were reviewed by more than one group of reviewers, as detailed in this section. Each land cover and land use indicator was reviewed both as an indicator proposed to answer a land question and as an indicator proposed to answer an ecological condition question. Table 2.4-1 shows the reviewers' overall recommendations for these indicators.

Table 2.4-1. Peer Reviewer Recommendations for Land Indicators

Indicators	Include with Suggested Modifications	Don't Include Unless Critical Modifications Are Made	Don't Include
Land Chemical			
Fertilizer applied for agricultural purposes	✔		
Reported toxic chemicals in wastes released, treated, recycled, or recovered for energy use	✔		
Pesticide residues in food	No consensus was reached.		
Pesticide-resistant arthropod species			✔
Pesticide poisonings	✔[2]		
Land Waste			
Quantity of municipal solid waste generated and managed	✔		
Quantity of RCRA hazardous waste generated and managed	✔		
Contaminated Lands			
Human exposure under control on contaminated lands	✔		
Contaminated groundwater under control on contaminated lands	✔		

[1] At the time of this peer review, EPA intended to publish the ROE Technical Document in 2006. Therefore, this summary of reviewer discussions refers to the "2006 Report on the Environment" and "ROE06." These terms are synonymous with all references to the "2007 Report on the Environment" and "ROE07" elsewhere in this report.

[2] This is the recommendation of the health group only. The land chemical group had no overall recommendation.

Land Cover			
Land cover	✔		
Forest extent and type	✔[3]		
Land Use			
Land use	✔		
Urbanization and population change	✔		

When the ecological condition reviewers reviewed an indicator, they ranked it in terms of its importance in answering the question it was proposed to answer. When ranking an indicator, the reviewers considered the indicator as it would be when revised according to the "critical" modifications they listed in the "Consensus" table. These rankings appear in the upper right-hand corner of each "Consensus" table prepared by the ecological condition reviewers. A "High" ranking represents the most important indicators. In cases where the ecological condition reviewers recommended not including an indicator, they did not assign a rank, and these indicators are labeled NA.

2.4.1 CHEMICALS USED ON THE LAND

2.4.1.1 Fertilizer Applied for Agricultural Purposes

Reviewed by the Land Chemical Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	None.
Suggested modifications	• For graphical representation of the data consider per-acre normalization of fertilizer use. Also, data in Figure 2 should be reduced to 1 or 2 significant figures. • This statement should be included under the limitations: Loading of nutrients into aquatic systems may not necessarily correlate with agricultural fertilizer use.
Other comments	See below.

In addition to the consensus statements above, all reviewers concurred on the following comments for this indicator.

Appropriateness, Adequacy, and Usefulness

The proposed indicator is largely appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in chemicals used on land and their effects on human health and the environment.

[3] Reviewers recommended including this as a land indicator, but reached no consensus regarding its inclusion as an ecological condition indicator.

- Fertilizer use in agriculture is still one of the principal uses of chemicals responsible for nutrient loadings into non-target water bodies, and for non-point source loading of nutrients within agricultural watersheds. In fact, the heavy use of fertilizer within the Watershed and tributaries of the Mississippi River are still considered to be a causative factor for the hypoxic zone within the Gulf of Mexico. Thus, this is a very appropriate indicator of chemical uses on land.
- While this indicator does reflect the trends in chemicals used on land, it is only an indirect indicator of their effects on human health and the environment because it does not measure how much of the fertilizer is taken up in the fertilized crops and how much runs off the fertilized fields, which is the real parameter of interest. Changes in management practices (e.g. buffer zones, dikes) as well as increasing yields could offset changes in application patterns.
- Although focused on large production regions for only the three major crops, the results are representative of production agriculture in other farmed areas where the variations in climate, cultivars and use patterns can still be expected to center around the general observations.

Extent to Which the Indicator Contributes to Answering the Question

The proposed indicator makes an important contribution to answering the question: What are the trends in chemicals used on the land and their effects on human health and the environment?

- As stated above, within agriculturally dominated watersheds nutrient loading into non-target water bodies, likely from fertilizer use is still a major source of non-point source pollution. From this standpoint, trends in fertilizer use provide valuable insight into these sources. Mitigating factors that could affect nutrient loading as a result of fertilizer use, such as slow-release formulations and agricultural practices that reduce runoff, could reduce the value of the indicator somewhat, but it still provides important information that should be included in the document.
- Graph 063.2 is less useful, although it may be of interest to those who want to know if the fertilizer use is near them.
- This indicator includes the most significant land application chemical use operations, possible rivaled only by turf and ornamentals production. In addition, alternative uses of the fertilizer chemicals in the system are so limited that all purchased product can be assumed to eventually be applied in an agricultural operation.

Meeting the Indicator Definition

The indicator fully meets the indicator definition.

- Trends in fertilizer use on a national basis, given the dominance of agricultural land use in the country, draw attention to potential increases or decreases in point and non-point source nutrient loading from agricultural lands. As these are numerical values that provide information on pressures exerted on the environment from specific use on a national scale, they meet the definition of an indicator.
- Data collected for one component are readily associated with numerical variables to verify scope and magnitude; i.e., data on N sales or usage in Region Z can be accurately correlated with crop type and acreage in the same region.

Meeting the Indicator Criteria

Indicator Criterion	Reviewer Comments
The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)	This indicator fully meets this criterion. This indicator is only an indirect indicator of runoff. Changes in management practices (e.g. buffer zones, dikes) could offset changes in application patterns.
The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.	This indicator fully meets this criterion.
The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.	This indicator largely meets this criterion.
Data are available to describe changes or trends, and the latest available data are timely.	This indicator fully meets this criterion.
The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.	This indicator largely meets this criterion. This indicator only partially meets this criterion because it is based on reporting that covers about half of the annual fertilizer use. See also indicator limitations.
The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.	This indicator fully meets this criterion.

- Generally, this indicator largely or fully meets all of the indicator criteria. As stated in earlier responses, it provides important trend information on the use of chemicals in the environment that can be responsible for adverse environmental impacts. It is objectively presented from the standpoint of use on agricultural land. While agriculture is unquestionably a large (arguably the largest) user of fertilizer, there are other uses as well (see "Additional Comments" below) and this caveat should be addressed, at least in a sentence, somewhere in the document. The data comes from The Fertilizer Institute (TFI) and U.S. Department of Agriculture (USDA) sources and is sound and up-to-date. While the farm-specific data are not available to the general public, creating a slight transparency issue, the data are aggregated and fulfills the purpose of showing national trends. On a year-to-year basis, the data are going to usually be comparable as they are encompassing use on crops accounting for the majority of agricultural production in the USA.
- The indicator employs sales, usage, acreage and application data that are non-proprietary, readily shared and rarely subject to misinformation. In addition, product sold can be utilized in numerous rotation, application or crisis strategies without compromising the value or usefulness of the fertilizer, or forcing destruction, abandonment or dumping because of unforeseen variation in a given season's production plans.

Graphic Presentation

- 063.1: Consider normalizing to acreage, if possible.
- 063.2: Reduce data to 1 or 2 significant figures.

Additional Comments

- As stated earlier, this indicator is included because of the adverse environmental effects of nutrient loading into aquatic ecosystems. The major concern with this indicator is that it focuses entirely on agricultural inputs; a reader (especially a lay reader) may be led to interpret this to mean that only agriculture is responsible for nutrient inputs. While agricultural interests are arguably the major users of fertilizer, these only account for about 85% of total fertilizer demand (Chemical and Engineering News, April 2000). Approximately 14% is associated with professional lawn care, consumer retail, and golf courses—all patterns associated with urban/suburban watersheds. While this is only 14% of total demand, many applications are made in close proximity to impervious surfaces (i.e., streets, parking lots, etc.) and may actually present a higher risk of runoff than agricultural settings. Nutrient loadings from turf runoff, septic systems, and sewage treatment plants often dominate loadings in suburban watersheds. The indicator that EPA is proposing to use is valid, but the above limitation should be noted as a limitation in the discussion.
- Including minor crops would be impossible, of course, but a summary indication of how tree crops and row crops represent the balance of fertilizer chemicals used in cited growing regions would be helpful.

2.4.1.2 Reported Toxic Chemicals in Wastes Released, Treated, Recycled, or Recovered for Energy Use

Reviewed by the Land Chemical Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	• Use graphical representation that was used in draft ROE 2003.
Suggested modifications	None.
Other comments	• See below.

In addition to the consensus statement above, all reviewers concurred on the following comments for this indicator.

Appropriateness, Adequacy, and Usefulness

The proposed indicator is largely appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in chemicals used on land and their effects on human health and the environment.

- Given that TRI reports on toxics produced as a part of the normal manufacturing process, this indicator provides valuable information and, when combined with agricultural fertilizer use, provides a nice picture of the chemicals used on land.
- It is appropriate and useful. It may not be 100% adequate due to the limitations noted, in particular the exclusion of a significant industry sector whose numbers and aggregate releases may not be constant over time.

- There are clearly gaps because of unreporting (ed) units or chemicals, and there does not appear to be any indicator recognition of gross errors, deception or fraud. In spite of these shortcomings it is a very valuable indicator.

Extent to Which the Indicator Contributes to Answering the Question

The proposed indicator makes a critical contribution to answering the question: What are the trends in chemicals used on the land and their effects on human health and the environment?

- While this indicator does not provide any information on effects, it does provide critical information on pressures put on the environment by the manufacturing sector. The discussion of this indicator in the technical document would be strengthened if some mention was made, and any trends could be established for specific chemicals, or chemical classes reported in TRI.
- This indicator contributes to the first part of the question—i.e. chemicals used, rather than effects.
- Because it monitors and measurers the effects of the most significant anthropogenic compounds in terms of both magnitude and toxicity entering our environment by design, all components of the indicator are ascribed to geographic or industry specific sectors.

Meeting the Indicator Definition

The indicator largely meets the indicator definition.

- The indicator meets this definition as it provides numerical information on a national basis and draws attention to trends in pressures exerted by chemicals used in or produced by manufacturing processes. The ability of this indicator to meet this definition is diminished somewhat as reporting requirements may be met through estimates of outputs through calculations, rather than actual measurements via monitoring efforts. However trends in data over time qualitatively should still yield valuable insight. It would be most useful if uncertainty measurements or estimates were provided wherever estimation methods or calculations of release are used.
- In spite of the latitude in methodology for measuring discharge by four (or more) direct, indirect or speculative means, the regulations do require a quantitative, reproducible basis for the determination of quantity, transformation and destination of reported substances.

Meeting the Indicator Criteria

Indicator Criterion	**Reviewer Comments**
The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)	The indicator fully meets this criterion.
The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.	The indicator fully meets this criterion.
The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.	The indicator largely meets this criterion.
Data are available to describe changes or trends, and the latest available data are timely.	The indicator fully meets this criterion.

Indicator Criterion	**Reviewer Comments**
The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.	The indicator only partly meets this criterion. Limitations due to reporting thresholds may mask trends over time. For example small businesses are a growing sector of the economy. It is possible that a growing percentage of all releases come from businesses that are below the reporting threshold.
The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.	The indicator fully meets this criterion.

- As stated earlier, this indicator provides very valuable information on trends in chemical pressures exerted on the environment by the manufacturing sector and thus answers the initial question posed in this section of the ROE. While objective, the indicator may be prone to bias by a small number of industries with relatively large releases of chemicals reportable under TRI. However this fact does not necessarily diminish the value of the indicator. In reporting these values it will be important to note specific areas of bias in each year of the ROE and make attempts to "break out" these data as was done in this year of the ROE for the mining sector. Additionally this indicator, and trends associated with this indicator, will be very prone to changes in legal reporting requirements in TRI impacting spatial and temporal comparability of the data. This is illustrated this year in the mining sector, where changes in legal reporting requirements have apparently strongly biased the trend data toward a decline. The challenge to EPA will be to make specific note of these biases and provide as complete an explanation as possible so that a reader may fully understand the limitations of the indicator.
- Because feedstock, systems and products are constantly changing, it is difficult to measure the utilization efficiency of many components and to therefore verify technical improvements. One could suggest a "risk cup" approach whereby reporting requirements are triggered by the product of unit size (# of employees) x quantities x risk (toxicity). Current reporting requirements favor escaping some regulatory oversight by compartmentalizing risky stages as small, independent operations.

Graphic Presentation

- The trends in releases described in the text are not very obvious on the current bar graph.
- There are a number of places for improvement. First, the precipitous decline in Figure 338.2 is apparently strongly biased by a court ruling that changed TRI reporting requirements for the mining sector and thus does not reflect actual release data over time (i.e. the data between years are not comparable). Reviewers suggested removing this figure and providing a more extensive discussion of this industrial sector in the document. The table associated with this figure provides very little information as greater than 99.5 percent of all release is to the land. This fact can also be stated in the text. Additionally, Figure 338.1 was difficult to interpret. Reviewers liked the way information on this indicator was graphically presented in the 2003 ROE technical document. In particular Exhibits 3-13 and 3-14 were particularly valuable. This indicator would benefit from presentation in table format of 1) changed thresholds for PBT chemicals described in the third indicator limitation and 2) a table of current and specifically new PBT chemicals added to the TRI. This information would "set the stage" for trend data and subsequent trend analysis that could be ultimately reported in the 2009 and 2012 ROEs.

Additional Comments

- There are a few typographical errors that should be corrected: in paragraph 4 on the first page, "categories" should be "category." In the QA/QC section under T1Q1, the acronym EPCRA should be defined. For T2Q3, the answer provided does not appear to address the question. In T4Q4, an additional statement should be added that changing legal reporting requirements would also influence the trend data. This is implied in the statement provided, but needs to be specifically stated.
- There is an extra "systems" in paragraph 1, and "categories" should be singular in paragraph 4. Paragraph 8 refers to "off-site transfers." Is this the same as "off-site releases" in 338.1? If so, please use the same term. If not, please explain the difference.
- It might be useful to estimate the number of facilities required to file TRI reports and the number not required to file TRI reports for each year to give the reader an idea whether there are any trends in that ratio.
- T2Q3: The answer should be "No."
- T4Q3: Does the variability described impact the conclusions that can be inferred from the data and the utility of the indicator?
- T4Q4: Might these gaps mislead a user about fundamental trends in the indicator over space or time period for which data are available?
- This is an indicator that clearly warrants more attention because of the potential effects of its subject materials, and the potential for unproven or risky practices.

2.4.1.3 Pesticide Residues in Food

Reviewed by the Land Chemical Group

Consensus Statements	
Overall recommendation	**The reviewers did not reach consensus on whether the indicator should be included, included with modifications, or not included.**
Point of divergence	• Pesticide residues in food are ambient conditions. The indicator may or may not be applicable to the question depending upon a reader's definition of ambient condition and environment. Specifically, the ROE question is not worded in such a way that explicitly includes ambient conditions and exposure to pesticide residues (i.e., Level 4 and 5 indicators), and raises the question of whether a food commodity is considered an environmental medium.
Critical modifications	• All reviewers agree that the data are excellent and provide very valid and valuable information. Therefore, reviewers suggest rewording the question to address these issues.
Suggested modifications	None.
Other comments	• See below.

In addition to the consensus statements above, all reviewers concurred on the following comments for this indicator, except where specified.

Appropriateness, Adequacy, and Usefulness

The proposed indicator is largely appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in chemicals used on land and their effects on human health and the environment.

- This indicator provides a very nice picture of the ambient condition of human exposure to pesticide residues in food samples. While it is not a direct indicator of pesticide use, it does provide information on relevant pesticide exposure to humans through use.
- The large amounts of excellent dietary exposure data generated in the existing program are extensively compromised as applied to the indicator because of the proscribed preparation protocols that restrict detection and measurement to arbitrary dietary norms.

Extent to Which the Indicator Contributes to Answering the Question

Reviewers did not agree on whether the proposed indicator makes an important contribution to answering the question: What are the trends in chemicals used on the land and their effects on human health and the environment?

One reviewer viewed the indicator as critical based on the following:

- This indicator does not address the "concentration of chemicals used on land found in the environment," unless one considers food as a component of the environment. Nonetheless, it is an excellent level 4 indicator that is closely related to dietary intake of pesticides (level 5). The closer to the table the sampling occurs, the closer it relates to level 5.

Two reviewers viewed the indicator as having minor importance based on the following:

- While this indicator does provide valuable information of the status of pesticide residues in the human food chain, it really does not make a critical contribution to answering the main question as 1) detection of pesticide residues in food does not provide any information on trends in actual pesticide use and 2) detection of pesticide residues in food does not provide any direct correlation to toxicological effects in humans and provides absolutely no information on effects in the environment.
- The procedures in this indicator barely address the "concentration of chemicals used on land found in the environment." Most of the residues are left behind, unquantitated, by the efforts to measure only normal dietary intake. The closer to the table that the sampling occurs, the less significant the residue data are to the indicator objectives. In defense of this reality it must be recognized that dietary intake is the objective of the USDA-PDP program. Its usefulness to EPA as an indicator data resource is limited.

Meeting the Indicator Definition

The indicator fully meets the indicator definition.

- Trends in pesticide residues in food ultimately provide long-term information on the ambient condition of exposure of humans to pesticides through the food-chain. While the crops these are measured on vary from year-to-year, the list of pesticides analyzed seems to be current with the most

widely used products on the market, and since these data are aggregated and national in scope, it meets the definition of an indicator.

- This indicator certainly meets the exposure or human health facets of the definition – hence the "4" – but the data being generated are inappropriate for their role as indicators of ambient distribution.

Meeting the Indicator Criteria

Indicator Criterion	**Reviewer Comments**
The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)	No consensus based on the point of divergence noted above regarding whether the indicator meets this criterion.
The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.	The indicator fully meets this criterion.
The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.	The indicator fully meets this criterion.
Data are available to describe changes or trends, and the latest available data are timely.	The indicator fully meets this criterion. However, data are not checked every year.
The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.	The indicator largely meets this criterion.
The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.	The indicator fully meets this criterion.

- Generally this indicator meets all of the above criteria. The overall quality of these data is without question due to the design of the USDA PDP program. However, as stated earlier trends are subject to changes on a year-to-year basis in the crops analyzed, which can impact the temporal comparability of the data. Additionally, pesticides have been added to the list of analytes in recent years to keep up with new products coming into the market. As stated in question 2 above, while this indicator does provide valuable insight into the ambient condition of pesticide residues in the human food chain, these values and the associated indicator do not provide direct information on the trends in chemical use and the effects on human health or the environment.
- These data meet all criteria for quality, comprehensiveness, reproducibility, etc.—all criteria except that of appropriateness for the issue at hand.

Graphic Presentation

- The graphical presentation in Figures 064-1, 064-2 and 064-3 are very nicely illustrated and adequately reflect the discussion in the associated text. There are a couple of typographical errors in the legend of 064-2 that need to be corrected: "analyzd" should be "analyzed" and in the same sentence, a space needs to be added between "samples" and "for."
- The part of the Y-axis from 60 to 100% should be eliminated and the part from 0 to 60% should be correspondingly expanded.

Additional Comments

- A statement should probably be added in the text of the discussion and in the QA/QC section (T4Q4) that the USDA PDP program does include most of the pesticides currently on the market. To someone reading this section and seeing the trend of increasing numbers of "zero pesticides detected" on crops, it is not apparent whether the list of pesticides analyzed in the PDP is current with the pesticides used in the marketplace. It would assist the reader if this were mentioned in two to three sentences in the text of the discussion of the indicator.
- The change in reporting of pesticide metabolites from 2002 to 2003 produced no apparent reduction in the percent of samples that had 2, 3, or 4 or more residues detected. It would be interesting to have some explanation for this unexpected result.
- If some modifications were made in the sampling and analysis protocols to include uneaten foliage and other matrices to which the chemicals are applied but that are not the consumed fraction, to consider analyzing the Raw Agricultural Commodity rather than only the edible fraction, or to also look at processing fractions, then perhaps these data could contribute significantly to the question that the indicator was intended to address.

2.4.1.4 Pesticide-Resistant Arthropod Species

Reviewed by the Land Chemical Group and the Ecological Condition Group (as a Referenced Indicator)

Land Chemical Group

Consensus Statements	
Overall recommendation	**Do not include.**
Critical modifications	• Not applicable.
Suggested modifications	• Not applicable.
Other comments	• See below.

In addition to the consensus statement above, all reviewers concurred on the following comments for this indicator.

Appropriateness, Adequacy, and Usefulness

The proposed indicator is somewhat appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in chemicals used on land and their effects on human health and the environment.

- This indicator is largely relying on cases of reports of resistance from literature sources rather than a hard systematic investigation of resistance of various species. In addition there are reasons that arthropods could develop resistance other than through continued use (or over-use) of a particular pesticide. The implication of this indicator would be that continued (and increased) use of pesticides would translate into increased incidence of resistance. This is not necessarily true. Additionally, incidence of pesticide resistance in arthropods would only provide potential information on effects

caused by use of insecticides and mitacides. It would provide virtually no information on herbicides or fungicides, where on a national basis, resistance is a bigger issue.

- It relies on an arbitrary recognition (i.e. peer-reviewed publications only) of the reporting of resistance development that may or may not have developed as the result of standard agricultural practices. Further, the member(s) of the compound class that elicited the resistance may not be correctly identified.

Extent to Which the Indicator Contributes to Answering the Question

The proposed indicator is of minor importance to answering the question: What are the trends in chemicals used on the land and their effects on human health and the environment?

- As stated above, the importance of this indicator is diminished, as it is limited only to insecticides. Its value would be greatly increased if it were extended to an aggregate value of incidence of pesticide resistant species including plants and fungi. In short, the indicator appears to be too narrow in scope.
- This indicator may be of interest to those who need to control insects, and to those in the pesticide business who have to continue developing new pesticides to try to stay ahead of the pests. However, it is not clear what it means to the general public. It has limited applicability to the ROE question it is intended to answer.
- There may sometimes be a negative correlation with pesticide application, as resistance frequently develops when less than recommended rates are used. This also allows for resistance to build in a non-target species that will only be recognized when it emerges as a resistant population in a nearby or recently introduced commercial operation.

Meeting the Indicator Definition

The indicator only partly meets the indicator definition.

- The indicator is not actually a direct measure of incidence of pesticide resistant arthropod species collected in a systematic manner, but a compilation of reports of incidence in the peer-reviewed literature. As it based solely on these reports, the geographical domain is unspecified. As it is not clear what data may or may not be published in a given year and from any particular location, it is not apparent how any trends in the data could directly relate to the condition of the environment.
- An arbitrary 10-fold ratio is specified to meet the resistance threshold definition, but this has no numerical bearing on the quantities being introduced to the reported boundaries of the ecosystem in which the resistance is described. Resistant populations can also inhabit large areas in which there are no significant treatments or host cultivation being conducted, and hence no observations.

Meeting the Indicator Criteria

Indicator Criterion	**Reviewer Comments**
The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)	The indicator only partly meets this criterion. This indicator has limited applicability to the ROE question it is intended to answer.
The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.	The indicator largely meets this criterion.

Indicator Criterion	**Reviewer Comments**
The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.	The indicator only partly meets this criterion.
Data are available to describe changes or trends, and the latest available data are timely.	The indicator only partly meets this criterion. There is a significant time lag in the data.
The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.	The indicator only partly meets this criterion. This indicator may not be comparable over time as the number of researchers doing this kind of investigation increases or decreases.
The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.	The indicator largely meets this criterion.

- The basis of some of these marks is provided in answers to the questions above. While the database of literature was undoubtedly collected in an objective manner, the underlying data in the individual papers are virtually impossible to subject to any quality assurance principles and the manner in which the data were collected is impossible to verify. The entire database is based upon peer-reviewed journal articles. It is difficult to say when a paper will be published in a given year and it is virtually impossible to state how the incidence data-reporting in the literature may translate into actual trends of resistance in the population of arthropods.
- The MSU reporting group follows their self-proscribed criteria, and may, in fact, trace the course of resistance outbreaks as long as the field reports match their criteria. They overestimate their topic's significance in that resistance is only a routine observation to much of the research community, and does not always merit a peer-reviewed airing. Many data appear in local extension notes that not only fall short of the monitoring group's standards, but may escape their notice entirely.

Graphic Presentation

- If this indicator is to be included in the 2006 ROE, the axis should be labeled in figure 225-1. Additionally, a statement was made in the "What the Data Show" section that the incidence of arthropod pesticide resistance is strongly correlated with the cumulative number of pesticide active ingredients registered by the U.S. EPA. Such a graph showing this correlation would make a nice addition to this section and should be added if at all possible.

Additional Comments

- If this indicator is to be included in the 2006 ROE, more explanation should be provided to help the reader interpret it. Is this cause for concern? Does it mean we are using too much or too many pesticides? Or too little or too few?
- T2Q3: The "answer" does not answer the question. In fact, there are no established reference points, thresholds or ranges of values that unambiguously reflect the state of the environment. This limits the usefulness of this indicator, because the reader has no idea what is good or bad. The reader can be imagined asking, "Should I be worried about this?"
- T4Q1-4: The inability to generalize these data to the areas that are not monitored limits their usefulness.

- Factors contributing to resistance are not always directly related to the product being applied that is believed to elicit the observation. Besides chemical class resistance, there is recent evidence that resistance may develop to two-gene transgenic crops, formerly believed immune to resistance development—this caused by the proximity of one-gene transgenic varieties.

Ecological Condition Group

Consensus Statements	
Overall recommendation	**Do not include.** (Rank: NA)
Reasons for exclusion	• While it is an ecologically important phenomenon, this indicator does not provide a clear measure of the state of the environment or the condition of ecological systems. • The survey may not continue. • The analytical capabilities, types of pesticides, and application rates have been changing. • Understanding of the index is complicated by the introduction of new compounds (i.e., the development of resistance depends on the presence of opportunities to develop resistance).

Individually, reviewers elaborated on several of the reasons why they recommended excluding the proposed indicator from ROE. For example, one reviewer observed that the study seems to have ended as of 2000, with no indication that it will continue. This reviewer also noted that the study focuses on newly registered chemicals, and provides no context in terms of usage rates.

Several reviewers also debated the interpretation of the indicator. As one noted, the rate at which species develop resistance is closely tied to the rate at which new compounds are introduced. In other words, the indicator "chases a moving target." This reviewer suggested that it might be more useful to analyze the evolution of resistance to a single major pesticide. Another reviewer added that the dataset appears to be from the agricultural community, so it may be focused only on pest species—not on the overall arthropod or invertebrate community.

Overall, at least one reviewer felt that the study represents interesting research, yet does not meet the standards for inclusion as an indicator.

2.4.1.5 Pesticide Poisonings

Reviewed by the Land Chemical Group and the Human Health Group

Land Chemical Group

Consensus Statements	
Overall recommendation	None.
Critical modifications	None.
Suggested modifications	None.
Other comments	• The indicator does not relate to the ROE question. However, the indicator may be an indicator of the toxicity of chemical products that are available to the general public. Data are good but do not address the question.

In addition to the consensus statement above, all reviewers concurred on the following comments for this indicator.

Appropriateness, Adequacy, and Usefulness

This indicator is somewhat appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in chemicals used on land and their effects on human health and the environment.

- Generally this appears to be a good indicator of trends of the effects of pesticides available for use rather than an effect on human health of pesticides used on land. Since all of these cases are based upon calls to poison control centers it is reasonable to assume they are mostly due to accidental exposure to a pesticide that is readily available, rather than from the actual use of the chemical (i.e. worker exposure).
- Pesticide poisoning reports are rarely based on scientific observation, but rather are initiated by unsolicited calls to poison control centers. Most cases are acute, and therefore less likely to indicate a widespread condition than to result from a unique event or accident. Chronic pesticide poisonings would be more interesting and relevant, but most chronic poisonings are first observed in a clinical context.

Importance for Answering the Question

This indicator is of minor importance to answering the question: What are the trends in chemicals used on the land and their effects on human health and the environment?

- See comments above. This indicator seems to provide more information on the toxicity of pesticides that are available to the general public rather than the toxic effects on people resulting from their use.
- Again, acute poisonings occur as a result of unique, random or accidental events, or as the result of unfortunate exposure to poorly maintained materials. A recognizable pattern rarely exists.

Additional Comments

- The indicator is straightforward, well presented, and easily understood; it provides important data on general human health effects and the relative trends in human toxicity of chemicals that are available to the public. However, it is questionable how well this indicator specifically addresses the question concerning chemicals used on land.
- Initial reports of poisonings are frequently ascribed to any pesticide operations in the vicinity—"chemical class profiling." Unfortunately, thorough followup investigations to determine the actual causes are not always conducted in instances where recovery is rapid or only pets, livestock or wildlife are involved.

Human Health Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	• Figure 276-2 (Exposure) should be deleted because "exposure" measurement is misleading; it represents only the fact that the poison center received a report, not that an actual exposure occurred.
Important modifications	• Data from the American Association of Poison Control Centers (AAPCC) represent the best available data, but at the same time EPA should clearly acknowledge that (1) poison control centers typically only capture between 24 and 34 percent of poisonings as cited in the indicator QA/QC documentation, (2) the data collection process is standardized, but is a passive system, and (3) data are collected by multiple poison centers with followup likely performed in different ways.
Other comments	None.

Peer reviewers voiced varied opinions on the utility and appropriateness of this indicator. Two reviewers initially voiced concern that, as presented, the data do not represent a useful measure of ambient condition, exposure, or human health condition and therefore do not meet basic indicator criteria. They questioned various aspects of the AAPCC data, but in the end the peer reviewers unanimously agreed that the indicator should be included as long as EPA clearly articulates what the data do and do not represent. The basis for the peer reviewer recommendations is elaborated below.

- **Data collection and reporting**. Much of the peer reviewer discussion centered on the following points related to the overall quality and representativeness of the AAPCC data.
    - The design of the AAPCC surveillance system is of general high quality, but not without inherent weaknesses and limitations. Most notable is the likely underreporting of poisonings. As cited in EPA's QA/QC documentation for this indicator, only 24 to 34 percent of poisonings are generally reported to poison control centers. In addition, reporting to poison centers is not complete nor does systematic followup occur.
    - The potential for misclassification and misinterpretation exists. Calls are recorded in different categories. Only confirmed clinical poisonings should be considered as valid indicator data. That

is, only those cases recorded in the Toxic Exposure Surveillance System (TESS) confirmed and categorized by a poison specialist should be used.

- Poison control centers generally have good reporting systems in place, but the effectiveness of systems across states and centers is expected to vary widely.
- The AAPCC data do not break data down demographically. Ideally, an indicator data set would be able to tease out observed differences among agricultural, rural, and urban settings; Aspelin (2003) offers such perspective in terms of pesticide use.
- The meaning of "exposure" was questioned; it was determined that the term was used to represent any report received by the AAPCC. The peer reviewers agreed that this use was incorrect and should not be used.

- **Appropriateness as an indicator**. Peer reviewers expressed a range of views on whether pesticide poisoning is a valid indicator of pesticide exposure. The final consensus was that the AAPCC data do meet EPA's indicator criteria, though not without limitations.
  - How does the reporting of poisonings relate to anything of interest to EPA? It is more a measure of misuse or abuse, rather than environmental exposure.
  - Because EPA controls all aspects of pesticide use and distribution (e.g., how formulated, labeled, containerized), tracking exposures through accidental poisonings is helpful. A decrease in poisonings may reflect decreased use of the more toxic pesticides, better labeling, etc.
  - Trends in pesticide use serve as a better indicator of potential pesticide exposure than reported poisonings (e.g., pesticide sales). It is not clear that a decline in poisonings represents a decline in exposures.
  - A recent article on pesticide poisonings in schools in the *Journal of the American Medical Association* (Alarcon et al. 2005) and CDC reports on mosquito control highlight the "liveliness" of pesticide exposure issues.
  - The data are equal in quality to those available for "reportable diseases." As long as EPA acknowledges that the numbers are not absolute numbers and represent counts of largely self-reported poisonings, the data are sufficient to serve as an indicator.

- **Figure 272-2 (Exposure)**. Based on discussions on indicator-related terminology, the peer reviewers agreed that Figure 272-2 should be deleted. As noted above, exposure as defined in this context simply means AAPCC received a report. This does not necessarily mean exposure occurred.

References

Alarcon WA, Calvert GM, Blondell JM, Mehler LN et al. 2005. Acute illnesses associated with pesticide exposure at schools. JAMA; 294:455-65.

Aspelin AL. 2003 Pesticide Usage in the United States: Trends During the 20th Century. Raleigh, NC: Center for Integrated Pest Management, North Carolina State University. February 2003.

2.4.2 WASTE

2.4.2.1 Quantity of Municipal Solid Waste Generated and Managed

Reviewed by the Land Waste Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	• Add this statement to the indicator text: The quantity of municipal solid waste placed on land does not necessarily track impacts on human health and the environment. Therefore this indicator is only an indirect measure of the actual risk of land disposal. • Clarify whether this indicator is intended to assess the impact of waste on all media or just land. • In other (i.e., non-land) chapters of the ROE, address the multimedia impacts associated with municipal solid waste management (e.g., greenhouse gases from landfills, incinerator emissions). • Add this statement to the indicator text: This indicator may not be appropriate to evaluate the impact of land-disposed waste on human health and the environment because there is no established direct link or relationship between quantity and impact. • In the indicator text, clearly state that the information on the materials flow methodology is proprietary and confidential and therefore not transparent. • In the indicator text, provide a more complete and organized list of all assumptions and limitations to the data used to generate this indicator. • Add the 2003 data on municipal solid waste generation. • Clearly define the target population. • Show all data points in the indicator graphics (not just every 10 years) to better appreciate fluctuation in generation rates.
Suggested modifications	• In the indicator text, state that the data generated by Franklin Associates are not reproducible by a third party.

The two land waste reviewers reached consensus on all the comments provided below for this indicator.

Appropriateness, Adequacy, and Usefulness

The proposed indicator is somewhat appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in wastes and their effects on human health and the environment.

The question posed is ambiguous on whether this indicator is used to assess impact of waste on all media or just land. The name of the indicator is inconsistent with the name of the group. Waste management impacts all media, not only the land. This indicator may not be appropriate to evaluate the impact of land-disposed waste on human health and the environment because there is no established direct link or relationship between quantity and impact.

MSW represents a fraction of the total land disposed wastes and some of these wastes are untreated prior to disposal (i.e., nonhazardous industrial wastes). EPA lists a relatively large number of limitations or gaps in the data that may mislead a user about fundamental trends in the indicator over the time period for which data are available. In the EPA comments, EPA dismisses this statement out of hand by saying, "The proposed MSW Generation and Management Indicator only includes information on those wastes that fall within the definition of MSW used by EPA." The responder goes on to say, "The waste streams mentioned can be quite large, however, the Agency does not regularly collect information on them, which is a requirement for an indicator." Finally the EPA responder states, "EPA intends to describe other significant categories of waste in additional information presented in the Land Chapter to provide as complete a picture of waste in the Unites States." This will change the basis of the data point unless the information is available for other past years and the data are recalculated before being presented. These wastes include:

- Non-hazardous industrial waste.
- Construction and demolition debris.
- Municipal wastewater treatment sludge.
- Automobile bodies.
- Combustion ash.
- Drinking water treatment sludge.
- Recycled materials and residues that find their way back into the MSW stream (value too low to recycle or items that were mistakenly added to this stream).
- Universal wastes.
- Household hazardous waste that is not separately collected.
- Land biosolids and composts.

Extent to Which the Indicator Contributes to Answering the Question

The proposed indicator makes an important contribution to answering the question: What are the trends in waste and their effects on human health and the environment?

As imperfect as this indicator may be, it seems to be consistent and covers a long period of time; therefore, it can pass the ***trend*** test.

Again, the indicator has limitations because it does not directly assess the effects on human health and the environment. In addition there are a number of multi-media issues related to waste management that must be considered by other ROE groups.

The number of landfills has declined significantly over time, suggesting a reduced impact to land. However, given the constant amount of waste generated and directed to landfills, this actually means a greater quantity buried per landfill. Does this mean there is less impact on human health and the environment? A large landfill may be easier to regulate than many small landfills and may benefit from economy of scale, however fugitive releases may be more difficult to detect. The concentration of wastes in large landfills may mean a larger local impact. Landfills are increasingly protective of the environment, however one must wonder about waste placed in landfills prior to RCRA regulations. These wastes may represent a more critical and cumulative impact.

Meeting the Indicator Definition

The proposed indicator only partly meets the indicator definition.

Because this indicator is based on the materials flow methodology, the data collected provide an indirect measurement. There is no actual measurement of the pressure on the environment due to MSW disposal or the amount of waste disposed of in landfills. Mass flow measurements are not scalable to regional levels.

The sense with this indicator is "trust us on this one!" Reviewers were **not** presented with a list of assumptions and limitations to the data used by EPA to generate this number, nor are they readily available. The EPA did not make available the information that it based its number on. The Chartwell Directory and Atlas of Solid Waste Disposal Facilities sells for $995. The ***Biocycle*** information is not available except by subscription. The EPA responded to this reviewer by saying that "These data are considered very credible." The EPA information in our review tab states: "Most of the data are from public sources for which the quality assurance and controls processes are not under the direct control of EPA." Further, the EPA states, "Because of the complexity, the study would not be readily reproducible by a third party." EPA also lists a relatively large number of limitations or gaps in the data that may mislead a user about fundamental trends in the indicator over the time period for which data are available.

Meeting the Indicator Criteria

Indicator Criterion	**Reviewer Comments**
The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)	The indicator only partly meets this criterion. EPA needs an indicator with a better link to human health and the environment. MSW is a significant fraction of land-disposed waste, but probably not the most important fraction of waste that may affect human health and the environment.
The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.	The indicator only partly meets this criterion. EPA has done little to test the accuracy of the mass flow calculations. Because of the nature of the Franklin study, there is no evidence that the information is clear and complete.
The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.	The indicator only partly meets this criterion. The data sources are primarily the Franklin studies and the Chartwell Atlas. The Franklin studies have been conducted for many years and the approach has been well scrutinized. However, there are no verified and disclosed data management systems and quality assurance practices in place. Since it cannot be applied locally, there is no means to verify its accuracy. Chartwell data depend on responses from states and according to the QA/QC report, only 80% of the states respond.
Data are available to describe changes or trends, and the latest available data are timely.	The indicator only partly meets this criterion. There is always a two-year lag in data collection. The 2003 data on MSW generation are now available and should be added.

Indicator Criterion	**Reviewer Comments**
The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.	The indicator doesn't meet this criterion at all. The target population has not been defined. If it is the population impacted by land contamination, then the quantity of MSW has not been directly linked to human health and the environment.
The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.	The indicator doesn't meet this criterion at all. By EPA admission, the data generated by Franklin are not reproducible; the process is not transparent due to protection of Franklin intellectual property.

Graphic Presentation

EPA should show all data points available to better appreciate fluctuation in generation rates. Will figures be presented in color? If not it may be difficult to interpret the data in the final document.

Additional Comments

Recyclers may place their "residuals" back into the MSW stream when the price for the commodities drops (e.g., glass prices are often unattractive for effective recycling). There are many items they receive from curbside pickups that are not recyclable. These items also find their way back into the MSW stream. EPA has no means of determining how significant these contributions may be. Once the recycled component has been subtracted from the MSW quantity, no corrections are made for this loop.

2.4.2.2 Quantity of RCRA Hazardous Waste Generated and Managed

Reviewed by the Land Waste Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	• Add this statement to the indicator text: The quantity of hazardous waste placed in land does not necessarily track impacts on human health and the environment. Therefore this indicator is only an indirect measure of the actual risk of land disposal. • In other (i.e., non-land) chapters of the ROE, address the multimedia impacts associated with hazardous waste management. • Since the data set is limited to two or three data points, eliminate references to trends in the indicator text. • Clearly define the target population. • In the indicator text, correct a typographical error by stating that the 18% decline in land disposal occurred in 2001 (not 2002 as currently written).
Suggested modifications	• In the indicator text, clarify that the universe of inclusions is not constant because the indicator measures the amount of legally defined hazardous waste, which changes annually due to the delisting process.

The two land waste reviewers reached consensus on all the comments provided below for this indicator.

Appropriateness, Adequacy, and Usefulness

The proposed indicator is somewhat appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in wastes and their effects on human health and the environment.

There are some gaps in these data for SQG and CESQG, as well as for wastes that may fall outside the regulatory definitions (and may be hazardous), exported hazardous wastes, and overly protective filers (generators of wastes that are not deemed hazardous).

Further, the quantity of hazardous waste placed in land does not necessarily track impact on human health and the environment. Thirty percent of the material is treated and placed in well-controlled landfills. Wastes that are deep-well injected are large in volume but fairly dilute, so the mass of the hazardous constituent is low. Therefore this indicator is only an indirect measure of the actual risk of land disposal. As with municipal solid waste, hazardous waste management has multi-media impacts that must be addressed by other indicators.

Extent to Which the Indicator Contributes to Answering the Question

The proposed indicator makes an important contribution to answering the question: What are the trends in waste and their effects on human health and the environment?

EPA may only have two data points (1999 and 2001). It is impossible to trend this limited amount of information. Assuming the data from 2003 are available, this still does not provide for rigorous trending information. There certainly are waste characteristics included in this metric that pose different level of risks.

Meeting the Indicator Definition

The indicator only partly meets the indicator definition.

The environmental coordinator positions in the waste-generating companies assigned with completing these biennial reports often turn over faster than the reports are completed. There is a significant learning curve that may affect data quality. While this is a more direct measurement of the selected indicator (quantity of waste generated) than MSW, there still is not direct link to human health or environmental effects.

Meeting the Indicator Criteria

Indicator Criterion	**Reviewer Comments**
The indicator makes an important contribution to answering a question for the ROE. (In this context, "important" means that the indicator answers a substantial portion of and/or a critical part of the question.)	This indicator only partly meets this criterion. The indicator has the following limitations: the legal definition of the hazardous waste may change, the waste quantity and the risks associated with the chosen management technique may not be linked, and changes in the regulations (such as the delisting mechanism) may impact quantities reported.

Indicator Criterion	**Reviewer Comments**
The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.	This indicator only partly meets this criterion. It is difficult to understand what is truly accounted for in the reported data and what is not when considering the potential for double counting, the fact that waste categorized as treated may also be land disposed, and the exclusion of SQGs and CESQGs. It is biased in that the indicator measures the quantity of legally defined hazardous waste rather than waste that truly poses a threat to human health and the environment.
The underlying data are characterized by sound collection methodologies, data management systems that protect its integrity, and quality assurance procedures.	This indicator largely meets this criterion. Cradle-to-grave monitoring of hazardous waste is well regulated and enforced and the negative consequences of false reporting are publicized. Hazardous Waste Reports are probably representative of hazardous waste generated by LGQs and managed by TSDFs.
Data are available to describe changes or trends, and the latest available data are timely.	This indicator doesn't meet this criterion at all. There can be no rigorous trends with two or three data points. The data are only collected every two years. There are situations that can happen within that timeframe that will not be identified in the two-year time frame.
The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.	This indicator only partly meets this criterion. The target population has not been identified. If it is the population impacted by land contamination, then the quantity of hazardous waste has not been directly linked to human health and the environment.
The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.	This indicator only partly meets this criterion. Double counting and the large number of management pathways for hazardous wastes reduce the clarity of the data.

Graphic Presentation

The reviewers have no suggestions for more effective graphic presentation of the data.

Additional Comments

There is a typographical error in the description that referenced a 2002 18% decline in land disposal that should be 2001.

2.4.3 CONTAMINATED LANDS

2.4.3.1 Human Exposure Under Control on Contaminated Lands

Reviewed by the Land Waste Group and the Human Health Group

Land Waste Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	• In the indicator text, add statements to clearly describe the indicator limitations detailed in the comments below. • For future versions of the ROE, look for alternative indicators to answer this question.
Suggested modifications	

Appropriateness, Adequacy, and Usefulness

This indicator is somewhat appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in contaminated lands and their effects on human health and the environment.

The indicator selected, human exposure under control, is an appropriate measure of the impact of contaminated lands. However, the National Priority List captures a small fraction of contaminated lands and these sites receive priority in assessment and remediation funded by the Superfund. There are thousands of leaking underground storage tank sites, RCRA corrective action sites, Department of Energy sites, and state sites missing from this list. Most of the RCRA Corrective Action sites are not currently included. It is questionable as to whether the percent of sites with human exposure under control at NPL sites reflects the trend for all sites with contaminated lands.

EPA determines whether "contamination is below protective, risk-based levels at NPL and high priority RCRA Corrective Action Sites." It is not clear that EPA has predetermined risk-based levels for all contaminants found at these sites. EPA claims that "'Unacceptable risk' is defined based on the cancer risk range." There are other human risks associated with these sites that lie outside of this assumption (e.g., endocrine disruptors). How significant might these be? The EPA is not including new sites that are discovered as a result of due diligence (All Appropriate Inquiry Rule) on property transfers. EPA is also not including new sites that are created with the "reportable quantity" spill response program. The indicator only looks at human health and does not look at the environment.

Importance for Answering the Question

This indicator is of minor importance to answering the question: What are the trends in contaminated lands and their effects on human health and the environment?

Trending might be impacted by the EPA statement, "Advances in risk assessment practice to better address sensitive populations will be automatically incorporated into the indicator as they are incorporated into practice" which may expand the number of sites in the future. They also need to

reassess the consistency of their risk assessments and the moving target of correcting previously conducted risk assessments for their impact on sensitive populations. Further, because the NPL sites receive priority in remediation, it is not likely that they necessarily reflect the trends for all sites with contaminated lands. EPA needs to rethink this indicator by studying the rest of the universe of contaminated lands that they are tracking to see if these could potentially skew the trend significantly.

EPA tracks all reportable quantity spills in the United States. Some of these spills have human exposures and ecological damage. They are not included in the Superfund list of sites that is tracked by this indicator. However, they are covered by the National Contingency Plan. There is a need to investigate whether the exclusion of reportable spills represents a significant impact on what this indicator has been suggested to measure.

Human Health Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	None.
Important modifications	• The indicator name should be changed to better reflect the fact that "exposure" is not being measured. The indicator represents the amount of "uncontained" waste, not exposure. For example: "Cleanup and control of hazardous waste sites." • EPA should discuss the indicator as a change in pressure or stressor as a source of exposure to humans (Level 3), not as an administrative action (Level 2). • The number and status of NPL and RCRA corrective action sites (clean or unclean) is important because exposure is a function of and/or influenced by the source and magnitude of toxic waste in the environmental media (air, water, soil). NPL sites are a primary source of concern, in particular for the approximately 40 million people who live within 2.5 miles of a site. Therefore, EPA should include information on the total number of NPL and RCRA sites and the proportion that have been remediated (e.g., ROE03, Exhibit 3-49). • For the future, EPA should work with other groups to determine the broader extent of contaminated lands across the country beyond NPL and RCRA sites. For example, EPA should initiate small studies to determine what portion of contaminated sites across the country are NPL and RCRA sites. • Also for the future, EPA should better monitor the exposure around NPL and RCRA sites. For example, EPA should work with ATSDR to collect biomeasure data at NPL and RCRA sites.
Other comments	None.

Peer reviewers voiced similar concerns regarding this indicator and spent a fair amount of time deciding how to best communicate their recommendations to EPA. Most concerns related to possible misinterpretation of the indicator and the fact that "exposure" was being measured for an unknown, but likely small, subset of contaminated lands across the nation. Initially, one of the four reviewers stated that the indicator should not be included in the ROE06 technical document. Another reviewer noted that this is

an important indicator associated with cleanup of contaminated lands. Given the large number of people living near contaminated lands, the magnitude of exposure warrants concern; this "simple" indicator offers a good surrogate for the effectiveness of remedial actions. A third reviewer noted, though, that data are not consistent across time and state. After discussion, however, the peer reviewers agreed unanimously that the indicator should be included, but with substantial modification. Peer reviewer concerns and recommendations are elaborated upon below.

- **Is the indicator definition met?** Peer reviewers expressed confusion as to what EPA meant by "under control." Does control reflect a one-time or continuous action? Could this be construed as an administrative indicator, which is not covered by ROE06, instead of an environmental indicator (e.g., changes in pressure or stressor quantities)? EPA explained that "under control" is determined based on methods that measure the extent of exposure between contaminated media and potential receptors (e.g., residents, on-site workers, children in daycare). EPA also explained that this indicator is a measure of interim progress prior to cleanup. After receiving this explanation, peer reviewers agreed that the indicator definition was met, but not before some additional discussion on defining "exposure" (see below). Because the indicator represents the amount of uncontained waste and not exposure, peer reviewers strongly recommended changing the name of the indicator to better reflect what it represents (e.g., "Cleanup and Control at Hazardous Waste Sites"). One reviewer emphasized that the write-up did not explain these points well.
- **Extent to which the indicator measures exposure**. One reviewer commented that the indicator was too limited in evaluating human exposure. Exposure is being measured based exclusively on the environmental concentration at the point of exposure. Biomarkers of exposure would be a better measure of exposure. Understanding that biomarker measures at sites were beyond the immediate purview of EPA and responsible parties, peer reviewers agreed that EPA should work with the Agency for Toxic Substances and Disease Registry (ATSDR) to build future data sets that might serve as better measures of exposures to contaminated lands. For the purposes of this indicator, peer reviewers agreed that exposure point concentrations serve as an adequate surrogate of exposure. However, as reiterated by one reviewer, EPA needs to be more transparent about describing what makes this an exposure indicator.
- **Better defining contaminated lands.** Peer reviewers questioned the denominator used in this "indicator equation," noting that the number and status of NPL and RCRA sites is a moving target. Further, peer reviewers commented that NPL and RCRA sites represent only a subset of contaminated lands across the country.
    - *NPL and RCRA sites*. The peer reviewers recommended that EPA include statistics on the total number of NPL and RCRA sites, pointing to Exhibit 3-49 in the draft ROE03 as a good compilation of such data and an important companion piece to this indicator. The reviewers questioned how the indicator accounts for changes in the number of high priority sites as cleanup of these sites is completed. One reviewer recommended displaying side-by-side bars representing new cohorts over time.
    - *Overall scope*. The peer reviewers questioned what percentage of total contaminated sites NPL and RCRA sites represent, recognizing that many smaller scale sites would not be counted as part of this indicator (e.g., small landfills, former industrial sites). One reviewer commented that the indicator—though narrow in scope—meets a need, but a broader public health issue exists; this indicator may only represent the tip of the iceberg. Another reviewer noted that NPL and RCRA sites might represent a small percentage overall, but are likely the worst and impact more people. However, some smaller sites could present greater risks. In light of these points, the peer reviewers recommended that EPA work with other groups to initiate studies to gather data on the number and status of non-NPL and RCRA hazardous waste sites.

2.4.3.2 Contaminated Groundwater Under Control on Contaminated Lands

Reviewed by the Land Waste Group and the Water Group

Land Waste Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	• In the indicator text, add statements to clearly describe the indicator limitations detailed in the comments below. • For future versions of the ROE, look for alternative indicators to answer this question.
Suggested modifications	None.

Appropriateness, Adequacy, and Usefulness

This indicator is somewhat appropriate, adequate, and useful for evaluating and/or contributing to an overall picture of the trends in contaminated lands and their effects on human health and the environment.

This indicator is more relevant to land contamination than the broad measurement of human exposure. It is surprising that the percent of sites that have groundwater under control is less than the number of sites with human exposure under control. "Groundwater under control" does not mean that there are no longer environmental and health impacts from other affected media. For example, some of the groundwater management techniques (e.g., air stripping) potentially have significant environmental and health impacts.

Importance for Answering the Question

This indicator is of minor importance for answering the question: What are the trends in contaminated lands and their effects on human health and the environment?

Groundwater contamination is probably the most important consequence of land contamination since a majority of the U.S. population depends on groundwater for potable and irrigation water. However, this indicator focuses only on NSP sites, which have higher cleanup likelihood than other contaminated sites. EPA needs to further test this indicator by studying the rest of the universe of contaminated lands that they are tracking to see if these could potentially skew the data significantly. Further, this indicator does not reflect other land-based exposure pathways such as surface water contamination and direct contact with contaminated soil or hazardous wastes.

Water Group

Consensus Statements	
Overall recommendation	**Include with modifications.**
Critical modifications	None.
Suggested modifications	• Consider presenting the size of the sites and/or the size of the population that may be relying on groundwater beneath these sites. Smaller or lower-priority sites could be included in this indicator if they serve a large population. • Clearly define this indicator as a pressure indicator. • Cross-reference this indicator with the indicator for *Nitrate and Pesticides in Groundwater in Agricultural Watersheds*. • Determine whether the data are adequate to present regional comparisons. • Define the symbol "GM" in the title of Figure 221-2.
Other comments	• This indicator could be linked with other indicators to show a response or effect. • This indicator is somewhat subjective because it relies on the judgment of the program manager to state whether any violations of standards have occurred. • The indicator text is misleading when it classifies the sampling techniques as well defined and standardized.

The water indicators peer reviewers agreed that this indicator, *Contaminated Groundwater Under Control on Contaminated Lands*, should be included in the ROE 2006 even if all of the suggested modifications cannot be made. The reviewers agreed that this indicator was well documented and clearly presented, with the exception that the indicator text did not clearly define it as an ambient or pressure indicator. The reviewers observed that EPA could link this indicator with other indicators to show a response or effect and encouraged the Agency to cross-reference this indicator with the indicator for *Nitrate and Pesticides in Groundwater in Agricultural Watersheds*.

The most important issue highlighted by the reviewers was related to the presentation of the indicator data. The reviewers contended that showing the percent of high-priority sites with migration of contaminated groundwater under control (Figure 221-1) did not take into account the size of the sites or the size of the population that may be relying on groundwater beneath these sites. In order to account for these differences, the reviewers recommended that EPA consider including smaller or lower-priority sites that serve large populations.

The reviewers suggested that because EPA collected the data by EPA regions, the Agency could present this indicator at both the regional and national levels. The regional data could be presented using pie charts for the different regions.

One reviewer remarked that this indicator is important because it integrates conditions across multiple states with different water quality and groundwater standards. However, the indicator is somewhat subjective because it relies on the judgment of the program manager to state whether any violations of

standards have occurred. In addition, the indicator text is somewhat misleading when it classifies the sampling techniques as well defined and standardized. At some Superfund sites, for instance, sampling techniques often must be adjusted to accommodate unique local conditions. Quality assurance plans and procedures are followed, however.

2.4.4 LAND COVER

2.4.4.1 Land Cover

Reviewed by the Ecological Condition Group, Both for Inclusion in the Land Chapter and for Inclusion as a Referenced Indicator in the Ecological Condition Chapter

Consensus Statements for the Indicator as a Land Indicator	
Overall recommendation	**Include with modifications.** (Rank: High)
Critical modifications	• To establish trends, future NLCD data will be required. The discussion of this indicator should emphasize the importance of continuing data collection, particularly the NLCD database. The reviewers encourage EPA and other federal government agencies to make every effort to guarantee future availability of the dataset. Assuming that EPA plans to use decadal development of NLCD, broad trends could develop through time, but would require many decades to develop robust trends. • Similarly, the discussion should emphasize the importance of continuing FIA data collection. • The indicator could include the National Heritage Program and Nature Conservancy pre-settlement map for context.
Suggested modifications	• The reviewers encourage EPA to explore ways to resolve a higher spatial resolution from the NLCD dataset (<30 m pixels) for urban land use analysis. • Explore whether more discriminatory attribute classes for urban and agricultural areas can be applied (e.g., MODIS). • The reviewers encourage EPA to work with other federal agencies to develop a standard land cover classification system. • Recognize the importance of discriminating between the types of "developed lands" and assessing their ecological impact. Although the data source will not support further breakdown by type/density of development, this may be worth noting as a limitation and/or suggestion for the future, given the importance of built density in determining ecological impacts.
Other comments	• It is impossible to evaluate the state of our nation's environment without rigorous land cover information. • The indicator is just a snapshot; there is no trend analysis.

Consensus Statements for the Indicator as a Referenced Ecological Condition Indicator	
Overall recommendation	**Include with modifications.** (Rank: Medium)
Critical modifications	• To establish trends, future NLCD data will be required. The discussion of this indicator should emphasize the importance of continuing data collection, particularly the NLCD database. The reviewers encourage EPA and other federal government agencies to make every effort to guarantee future availability of the dataset. Assuming that EPA plans to use decadal development of NLCD, broad trends could develop through time, but would require many decades to develop robust trends. • Similarly, the discussion should emphasize the importance of continuing FIA data collection.
Suggested modifications	• Recognize the importance of discriminating between the types of "developed lands" and assessing their ecological impact. Although the data source will not support further breakdown by type/density of development, this may be worth noting as a limitation and/or suggestion for the future, given the importance of built density in determining ecological impacts.
Other comments	• It is impossible to evaluate the state of our nation's environment without rigorous land cover information. • The indicator is just a snapshot; there is no trend analysis.

Individually, the reviewers noted several limitations and areas of concern. For example, one reviewer observed that EPA regions might not be useful to the average member of the audience. Others pointed out that while the graphics may be well presented, they still only show a snapshot in time. One reviewer noted that the ability to depict trends is clearly contingent on the availability of additional NLCD data in the future. All reviewers agreed that the indicator writeup should include a strong statement encouraging continued NLCD data collection.

A reviewer suggested that it might be helpful to include a pre-settlement land cover map for context. This reviewer added that the historical map would not have to include pie charts like the existing figures, but would work fine as just a simple picture. Other reviewers agreed, and one specifically suggested some pre-settlement maps that have been published by the Nature Conservancy and the National Heritage Program. However, the reviewers noted that there is not much information to fill the gap between pre-settlement times and about the 1970s, In particular, one reviewer mentioned that there is no thorough map of land cover circa 1900.

One of the major weaknesses identified by reviewers is that land use and land cover classes are not finely tuned for modeling ecological condition. For example, the proposed indicator does not consider different types of agricultural land, and it lumps all "developed" lands into a single category. As one reviewer noted, the amount of developed land does not tell the whole story, because a small area of developed land can have a large ecological impact. To classify developed lands in more useful terms, one reviewer suggested finding the density of developed areas using census data. Another reviewer agreed that this would be doable, but cautioned that the NLCD database (the indicator data source) would not support such an analysis. This reviewer noted that the NLCD data are based on 30-meter pixels, and while some breakdown might be possible, it would require a lot of analysis. Further, a few targeted high-resolution

analyses would not be very useful, since there is a lot of variability in developed lands across the country. Nonetheless, the reviewer noted that even if pixel size stays the same, spectral instruments are improving. Another reviewer added that analytical processes are also improving. The reviewers agreed that the new MODIS system would be a good model to consider.

Finally, looking at the bigger picture of spectral data collection, several reviewers expressed their strong feeling that the government can simply do better than NLCD. One reviewer cautioned that different agencies have collected data for different objectives, and noted that budget sharing is difficult. However, several reviewers emphasized that it would be good to see a single national classification scheme that is sensitive to all the needs of the end users of the data, including those who want to use the data to model ecological condition.

2.4.4.2 Forest Extent and Type

Reviewed by the Ecological Condition Group, Both for Inclusion in the Land Chapter and for Inclusion as a Referenced Indicator in the Ecological Condition Chapter

Consensus Statements for the Indicator as a Land Indicator	
Overall recommendation	**Include with modifications.** (Rank: High)
Critical modifications	• The indicator needs to provide a better explanation of which forest lands are included, and provide examples of forest lands that are not included.
Suggested modifications	• Graphics are not displayed on a consistent temporal scale, although this may be due to the constraints of the FIA database. Standardization would facilitate comparison. • If the data are adequate, extend Figure 4 to an earlier timeframe to provide longer-term trends. • In Figure 5, consider including 1907 data for comparison.
Other comments	• The species breakdown (e.g., Figure 4a) makes this a potentially useful indicator.

Consensus Statements for the Indicator as a Referenced Ecological Condition Indicator	
Overall recommendation	**No consensus.** (Rank: Medium)
	• The reviewers disagree on the importance of this indicator as a descriptor of ecological condition. Several reviewers see the information as largely descriptive (e.g., a snapshot in time) and already incorporated within other indicators, and thus they feel the indicator should not be included in the ecological condition chapter. However, other comments emphasize the value of Figure 4 in disaggregating data by species/forest type.
Suggested modifications	• Graphics are not displayed on a consistent temporal scale, although this may be due to the constraints of the FIA database. Standardization would facilitate comparison. • If the data are adequate, extend Figure 4 to an earlier timeframe to provide longer-term trends. • In Figure 5, consider including 1907 data for comparison.
Other comments	• The species breakdown (e.g., Figure 4a) makes this a potentially useful indicator. • Aside from the species breakdown, the information in this indicator is already presented elsewhere in the ROE. Other indicators use FIA data more effectively to project ecological function.

As a general indicator of land cover, the reviewers agreed, Forest Extent and Type provides useful contextual information. However, as noted in the consensus statements, the reviewers saw less value in the indicator as a measure of ecological condition.

In their individual comments, reviewers noted several weaknesses to the proposed indicator, including the following:

- The distinction between forest and timberland is not important to the public.
- Figure 1 shows no meaningful trend, and has a huge time gap between the baseline (1630) and the first modern data point (1907). However, another reviewer suggested that the trend might be lost because the data are not broken down by region. All reviewers eventually agreed that Figure 1 is not useful, and the indicator would do just as well to present a single map of forest cover.
- Figure 3 shows good temporal trends, but the information has already been presented more effectively in other indicators.
- Figures 4 and 5 give more of a snapshot than an indication of long-term trends.
- The indicator does not include Alaska. However, another reviewer noted that even with commercial harvesting, Alaskan forestland essentially all remains forestland; it is not being converted to agriculture or development.
- Forest type data may not have been as well disaggregated in the earlier years of FIA, so the figures do not all have the same temporal scale.

With regard to including this indicator in the ecological chapter, one reviewer noted that FIA data have already been used more effectively to project ecological functions in other indicators. However, another reviewer acknowledged that the indicator is relevant to ecological patterns, while a third reviewer spoke strongly in favor of keeping the indicator because it serves as a good foundation for other indicators. This reviewer also argued that the indicator is useful because Figure 4 breaks forests down by type and species, which no other indicators do. Conversely, another reviewer pointed out that Figure 4 only shows the major species in each forest type—which are already known to grow naturally in a given region. Another reviewer argued that even if Figure 4 is a good representation of species, it does not really help with the interpretation of any other indicators.

Overall, the reviewers could not reach a consensus on including the indicator in the Ecological Condition chapter. However, they did agree that it can be presented in the Land chapter, so long as critical modifications are made.

Finally, the reviewers made a few suggestions for the future, should there be an opportunity to expand this indicator. Individual comments include the following:

- Co-locating birds with forest type would be an important and useful linkage.
- It would be interesting to see forest fragmentation broken down by forest type. However, another reviewer noted that the current Forest Fragmentation indicator would not provide a useful species breakdown because it is limited to a comparison of East versus West.
- The FIA database includes data from 1907. If the data support it, it would be interesting to compare 1907 data with the recent trends in Figure 5.

2.4.5 LAND USE

2.4.5.1 Land Use

Reviewed by the Ecological Condition Group, Both for Inclusion in the Land Chapter and for Inclusion as a Referenced Indicator in the Ecological Condition Chapter

Consensus Statements for the Indicator as a Land Indicator	
Overall recommendation	**Include with modifications.** (Rank: High)
Critical modifications	• If possible, the indicator could distinguish among types of agricultural uses (e.g., crop types).
Suggested modifications	• Land use is necessarily more difficult to compile than land cover, requiring many separate data sources and classification interpretations. This system has sufficient classification granularity for non-urban uses, but is totally inadequate for "developed" lands. Also, maps of use and use change are needed to show differential geographic impacts of land use change. Some types of change and locations (residential growth in coastal areas) are more important to more sensitive ecosystems. The indicator currently lacks this information. EPA could improve the indicator by using one of the existing land use classifications, such as the modified Anderson system, which lends itself to multiple resolutions and remote sensing data at regional scales.
Other comments	• Figure 3 is the most informative of the figures.

Consensus Statements for the Indicator as a Referenced Ecological Condition Indicator	
Overall recommendation	**Include with modifications.** (Rank: Medium)
Critical modifications	• Figures 1 and 2 should be accompanied by text that strongly emphasizes the disproportionate impact of developed lands. Without this information, the figures may be misleading.
Suggested modifications	• Land use is necessarily more difficult to compile than land cover, requiring many separate data sources and classification interpretations. This system has sufficient classification granularity for non-urban uses, but is totally inadequate for "developed" lands. Also, maps of use and use change are needed to show differential geographic impacts of land use change. Some types of change and locations (residential growth in coastal areas) are more important to more sensitive ecosystems. The indicator currently lacks this information. EPA could improve the indicator by using one of the existing land use classifications, such as the modified Anderson system, which lends itself to multiple resolutions and remote sensing data at regional scales. • The indicator should also distinguish among types of agricultural lands/crops.

Consensus Statements for the Indicator as a Referenced Ecological Condition Indicator	
Other comments	• Although imperfect, this indicator it is the best available to characterize land use. • Figure 3 is the most informative of the figures.

In their individual comments, reviewers discussed the interrelationship between land use and land cover, with one reviewer noting that if one has land use data, one can often use it to infer land cover. Several reviewers reiterated comments they made in relation to the Land Cover indicator (see the Land Cover discussion), particularly regarding the need for a strong statement in favor of continuing NLCD data collection, which would allow this indicator to show trends in the future.

One reviewer pointed out that the indicator would benefit from better and more consistent land use classifications, particularly with regard to characterizing ecological effects associated with changes in these indicators. One reviewer expressed interest in seeing agricultural land separated into pastures and cropland, since there can be substantial ecological differences between the two. Another reviewer added that ecological impacts also differ by type of crop, including indirect effects related to the selection of pesticides. A third reviewer added that different crops have different spectral signals, which can be distinguished with about 60% accuracy—although another reviewer pointed out that the indicator may not warrant this level of detail.

In addition to agricultural lands, one reviewer suggested that it might be useful to break urban land into more specific categories. However, this reviewer noted that urban areas are more complex than agricultural areas because they do not have predictable patterns, and thus require many small shots at a high spatial resolution. Further, while urban planning databases are available, the reviewer pointed out that they do not all share the same classification scheme and they do not all use GIS. Another reviewer suggested using property management/tax assessment databases, but noted that these data are not always publicly available. However, a third reviewer suggested that it might not be as important to distinguish among the types of developed lands for this indicator as it would be for the indicator on land cover (see Land Cover comments).

Another weakness identified by the reviewers is the lack of statistical metadata for this indicator. As one reviewer observed, there is no clear indication of the relative accuracy of classification. Thus, while it appears there is a trend in crop/pasture land, it is not clear that this trend is statistically significant. In this case, the reviewer suggested that error bars could help, although another pointed out that no other indicators use error bars, even though many probably could.

As noted in the discussion on land cover, the reviewers agreed overall that there is a strong need for a better national system of land use/land cover data collection. Reviewers noted that several agencies have useful programs—e.g., USDA's county-by-county NRI analysis—yet overall, there is a need for more standardized classification, particularly where ecological effects are concerned.

2.4.5.2 Urbanization and Population Change

Reviewed by the Ecological Condition Group, Both for Inclusion in the Land Chapter and for Inclusion as a Referenced Indicator in the Ecological Condition Chapter

Consensus Statements for the Indicator as a Land Indicator	
Overall recommendation	**Include.** (Rank: High)
Critical modifications	• None required.

Consensus Statements for the Indicator as a Referenced Ecological Condition Indicator	
Overall recommendation	**Include.** (Rank: Medium)
Critical modifications	• None required.
Other comments	• In their discussion of new indicators, reviewers will suggest more robust indicators of population impacts (such as ecological footprint).

The reviewers agreed that the indicator is adequate for ROE as is, and that it does not require any modification. However, in their individual comments, they did discuss some limitations, as well as opportunities to expand the indicator in the future.

Regarding the indicator presentation, one reviewer suggested that instead of EPA regions, the indicator could provide a higher-resolution national map showing areas of change, which would be more meaningful to the general audience than a map with EPA regions. Another reviewer suggested superimposing regional bar graphs on the existing map.

Other individual comments focused on the concept of urbanization as a stressor to ecological systems. One reviewer emphasized that it is important not only to identify urbanization as a stressor, but also to understand how the impacts of urbanization have changed over time. As two reviewers pointed out, in the U.S., the increase in development has outpaced the increase in the population because per capita impacts and living standards have also risen over time. However, one of these reviewers also noted that it is difficult to translate population into environmental trends because the relationship between population and development is non-linear—i.e., not easily characterized by a weighting factor.

While they recognized the difficulty in translating population growth into environmental impact, the reviewers offered several examples of existing efforts in this area, some of which could serve as models for future indicators. One reviewer also suggested referencing some of these efforts in the writeup. Individual suggestions included:

- "Ecological footprint" studies—although a reviewer noted that many of these have compared the U.S. with other countries, but have not compared areas within the U.S. Another reviewer cautioned that qualitative "cultural" factors are often included in these footprint calculations.
- "Urban funnel" studies—although a reviewer cautioned that a large footprint for a small area is actually desirable if one prefers density over sprawl.
- Other attempts to assess per capita ecological impacts (e.g., work by Costanza).

One reviewer also noted that ecological effects are not necessarily limited to the exact location where population growth is occurring. For example, growth in the Southeast could necessitate increased food production across the nation—which could in turn affect ecosystems as far away as Southern California.

Despite the inherent difficulty of translating population change into measurable ecological trends, one reviewer emphasized that the indicator still provides important foundational information that other ecological indicators can build upon. Another reviewer agreed, noting that population is clearly a major driver of ecological impacts—a link underscored by Figure 1.

2.4.6 RESPONSE TO GENERAL QUESTIONS FOR LAND CHEMICAL INDICATORS

Provided by the Land Chemical Group

2.4.6.1 General Question 1: Relative Value and Importance of Indicators

Reviewers reached consensus on the following response to General Question 1:

Fertilizer and TRI reporting indicators are the most important for answering the ROE question. The pesticide-resistant arthropod species indicator was less important to not important. Pesticide poisoning was slightly more important than the arthropod species indicator. These data are questionable in their consistency and do not address the question. The pesticide residues indicator is intermediate, since no consensus was reached due to significant divergence among the reviewers.

2.4.6.2 General Question 2: Proposed New Indicators

Reviewers reached consensus on the following response to General Question 2:

- Reviewers concurred with EPA's decision to exclude indicators in the 2006 ROE that were previously included in the draft 2003 ROE.
- Reviewers suggest using another indicator, such as pesticide sales, to better address the ROE question. Such sales data could potentially be obtained from state regulatory authorities to access dealer records for purchasing/sales information.
- Reviewers expressed concern that chemicals in wastewater streams may have biological activity, while acknowledging that there are insufficient data to address this concern. In the future, as data are developed for human health, veterinary pharmaceuticals, and endogenous metabolites (e.g., hormones, etc.), EPA should monitor national-level data on this class of chemicals. At some future time, pharmaceutical sales, number of drugs prescribed, and wastewater concentrations of chemicals with biological activity could become potential significant indicators.

2.4.7 RESPONSE TO GENERAL QUESTIONS FOR LAND WASTE INDICATORS

Provided by the Land Waste Group

2.4.7.1 General Question 1: Relative Value and Importance of Indicators

Both of the indicators submitted for peer review have potential significant problems that affect their usefulness to the Report on the Environment. Because of the delegation of MSW regulation to the states, there seem to be fewer national databases regarding land-based MSW disposal. The Franklin studies provide the best approach available for determining MSW quantity, but because of their nature, they cannot be verified locally, they are not reproducible, and the process is not transparent. Neither indicator

is directly linked to human health and the environment. Hazardous waste reports provide direct measurement of the indicator although limitations exist with respect to the legal definition of hazardous waste, the exclusion of SQGs and CESQGs, and missing reportable spill data.

2.4.7.2 General Question 2: Proposed New Indicators

- Construction and demolition waste can be projected using economic trends, building permits, etc. Several studies have been conducted that also project waste quantities using economic factors.
- Many states collect detailed MSW generation and management data that may be more accurate on a local basis than the Franklin study or may be used to test Franklin national data.
- EPA could consider changing the hazardous waste indicator to a ***leading*** indicator—"The amount of money EPA commits to waste minimization and pollution prevention technical assistance and research as a fraction of the total EPA operating budget." This indicator is measurable and can be back calculated. EPA stated, "The RCRA program continues to pursue the goal of reducing or eliminating the generation of hazardous waste." However, their funding (e.g., PPIS Grants) of pollution prevention and waste minimization has been on the decline. They do not even have a budget to reprint their publication, *An Organizational Guide to Pollution Prevention* (EPA/625/R-01/003, August 2001). There is a clear link between waste minimization and pollution prevention and reductions of the effects of hazardous wastes on human health and the environment. EPA could create a similar ***leading*** indicator to the one proposed for hazardous waste minimization and pollution prevention. The EPA needs to demonstrate its commitment to prevention and "walk the talk" in its own programs to conform with federal facility requirements under Presidential Executive Order 13148.
- EPA could consider using their voluntary Green Chemistry program results as a measure of the amount of hazardous waste that has been generated. Through 2005, the program winners have reported nearly half billion pounds of waste avoided. The more waste avoided the less potential impact on human health and the environment.

2.4.8 RESPONSE TO GENERAL QUESTIONS FOR CONTAMINATED LANDS INDICATORS

Provided by the Land Waste Group

2.4.8.1 General Question 1: Relative Value and Importance of Indicators

Both of the indicators submitted for peer review have potentially significant problems that affect their utility for the purpose of including them in the "Report on the Environment." There is a lack of consensus between reviewers as to whether the requested response is limited to land contamination issues or to the broader impact of sites on air and water. Clearly a site with controlled groundwater could still pose significant threat to human health and the environment as a result of the transfer of pollutants from the ground to the air and the discharge of treated groundwater to the waters of the U.S. If the impact is only related to land, then the percent of sites with contaminated groundwater under control may be more relevant to land contamination than the broad measurement of human exposure.

2.4.8.2 General Question 2: Proposed New Indicators

The reviewers had no suggestions for additional national indicators that would meet the indicator criteria.

2.4.9 RESPONSE TO GENERAL QUESTIONS FOR LAND COVER INDICATORS

Provided by the Ecological Condition Group

2.4.9.1 General Question 1: Relative Value and Importance of Indicators

The reviewers ranked both of the proposed indicators as "High" for inclusion in the Land chapter, noting that it is impossible to assess the state of the nation's environment without rigorous land cover information. The proposed indicators do have limitations related to data collection—Land Cover is just a single snapshot in time, without highly refined classes for agricultural and developed land cover, while Forest Extent and Type also has temporal limitations. However, the reviewers agreed that these two indicators provide vital context for discussions that occur elsewhere in ROE, and should be included. Note that many of the reviewers' reservations about Forest Extent and Type concerned its usefulness as an indicator of Ecological Condition, not its inclusion in the Land chapter.

2.4.9.2 General Question 2: Proposed New Indicators

While they did not propose any new indicators of land cover, the Ecological Condition reviewers suggested a number of ways in which the present indicators might be augmented or improved in the future. For example, the reviewers stressed the importance of continuing data collection, so snapshot indicators like Land Cover can be converted into trend analyses. Reviewers also suggested ways the land cover classes might be improved and standardized in the future, which would facilitate more in-depth analyses. Such changes would be particularly helpful to those who use land cover data to make inferences about ecological condition. Other suggestions about land cover indicators are captured within the discussions and consensus statements for each of the individual indicators.

2.4.10 RESPONSE TO GENERAL QUESTIONS FOR LAND USE INDICATORS

Provided by the Ecological Condition Group

2.4.10.1 General Question 1: Relative Value and Importance of Indicators

Reviewers ranked both land use indicators "High" for inclusion in the Land chapter, noting that they both provide important contextual information for understanding environmental stressors. The reviewers did not see any need to modify the indicator Urbanization and Population Change, and their recommended modifications to the Land Use indicator were not critical in nature.

2.4.10.2 General Question 2: Proposed New Indicators

The reviewers did not explicitly identify any new indicators that could be developed to answer this question. However, they suggested several ways to improve land use data collection, which could lead to more robust indicators in the future. These suggestions are the same as the recommendations described in the previous section on land cover—namely, a standardized national system to collect timely high-resolution data and characterize the data with a useful, consistent classification system. In their discussion of these indicators, the reviewers also expressed interest in exploring ways to depict ecological footprint or per capita impact. However, these were suggested for development as indicators of Ecological Condition, not Land.